

国产四种绢藓属植物的核型研究*

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A KARYOLOGICAL STUDY ON FOUR SPECIES OF *ENTODON* (MUSCI) FROM CHINA

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Abstract This paper deals with karyological studies on four species of the genus *Entodon* from China. The metaphase and heteropycnotic chromosomes in mitotic cells of gametophytes were observed. All the four species showed the same chromosome number of $n=11$. Their karyotypes were formulated as $K(n)=11=2V(H)+2J+6(4v+2i)+m(h)$ in *E. obtusatus*, *E. compressus*, *E. okamurai* and $K(n)=11=2V(H)+1V+2J+5(3v+2i)+m(h)$ in *E. giraldii*, respectively.

Key words *Entodon*; Karyology

摘要 国产苔藓植物的核型研究,目前尚未见到任何报道。本文对中国产绢藓属4种植物进行了核型研究。观察了配子体有丝分裂中期的染色体和异染色体。4种植物的染色体数目均为11。钝叶绢藓(*E. obtusatus*),密叶绢藓(*E. compressus*),东亚绢藓(*E. okamurai*),的核型公式为 $K(n)=11=2V(H)+2J+6(4v+2i)+m(h)$,陕西绢藓(*E. giraldii*)为 $K(n)=11=2V(H)+V+2J+5(3v+2i)+m(h)$ 。4种植物的核型均为首次报道。

关键词 绢藓属;核型

Introduction

The karyology of bryophytes has been extensively studied in various countries (Anderson, 1984), while the karyology of the Chinese bryophytes is little known. Up to date, only four species of the Chinese bryophytes have had chromosome counts (Zhou et al., 1988), and karyotype analysis has never been performed.

In the present paper, four species of the genus *Entodon* (Entodontaceae) from China were karyologically investigated. The chromosome numbers of three species and all the

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karyotypes are reported here for the first time.

Materials and Methods

The locality information of the materials is listed in Table 1. The voucher specimens were deposited in the Herbarium of the Department of Biology, Qiqihar Teacher's College, Helongjiang Province, China.

For the karyological observations, stem tips of the gametophytes were pretreated in 1 : 1 mixture of saturated p-dichlorobenzene and 1% α -bromonaphthalene for 1—2 hours at 10°C before they were fixed in 3 : 1 mixture of absolute alcohol and glacial acetic acid. They

Table 1 chromosome number for 4 *Entodon* species

Species	Chromosome number	Voucher	Locality	Fig.
<i>Entodon obtusatus</i>	11	W. Sha and X. J. Yang 900003	Qiqihar	1
<i>E. compressus</i>	11	W. Sha and B. Pan 911004	Nianzishan	2
<i>E. okamurae</i>	11	W. Sha and X. J. Yang 900021	Qiqihar	3
<i>E. giraldii</i>	11	W. Sha and B. Pan 911002	Nianzishan	4

were then hydrolyzed in 1 : 1 mixture of hydrochloric acid and 95% alcohol for 15—20 minutes. After being washed with water, they were stained with carbol fuchsin and then preparations were made for observation. Many cells with well-dispersed chromosomes were observed, from which 5—7 cells were chosen for karyotype analysis.

Karyotype formula of each species was based on the measurements of chromosomes. The relative length of each chromosome was calculated by:

$$\frac{\text{chromosome length}}{\text{total length of the chromosomes of karyotype}} \times 100$$

Position of the centromeres was estimated by the value of F% as calculated by:

$$\frac{\text{short arm}}{\text{total length of the chromosome (short arm + long arm)}} \times 100$$

The symbols for the karyotype description are as follows: V=large chromosome with F%=50—40; J=large chromosome with F%=39—13; I=large chromosome with F%=12—0; v, j and i=small chromosome with the same F% value as V, J and I; m=the smallest chromosome; H=large heteropycnotic chromosome and h=small heteropycnotic chromosome. To show the size of each chromosome, the length of the longest chromosome is used as the basic length. If a given chromosome has a length shorter than half the length of the basic one, it is classified as the small type. If a given chromosome has a length longer than half the length of the basic one, it is classified as the large type.

Results

All the four species showed the same chromosome number of $n=11$. Their karyotypes are described in detail as below.

(1) *Entodon obtusatus* Broth. , Plate 1 : 1, Fig. 1, Table 2

The chromosomes were counted to be $n=11$, consisting of four large and seven small ones. This count was further confirmed by our observation on meiosis of the spore mother cells. The largest chromosome was $3.89\ \mu\text{m}$ long and V-shaped with $F\%=44.09$. This chromosome showed heteropycnosis on the long arm and thus belonged to H-chromosome. The other three large chromosomes included one V-shaped, which showed heteropycnosis on the short arm and thus belonged to H-chromosome, and two J-shaped. The small chromosomes comprised four v-shaped, two i-shaped, and one m-chromosome which showed heteropycnosis. Thus the karyotype of this species was formulated as $K(n)=11=2V(H)+2J+6(4v+2i)+m(h)$. The total length of the chromosome complement was $18.39\ \mu\text{m}$.

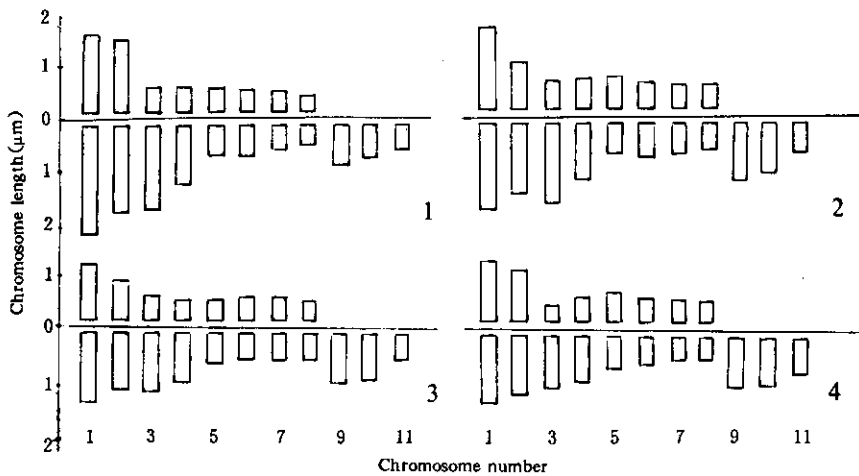


Fig. 1—4 The idiogram of 4 *Entodon* species

(2) *Entodon compressus* (Hedw.) C. , Muell. , Plate 1 : 2, Fig. 2, Table 2

This species had the chromosome number of $n=11$, which is reported here for the first time. The largest chromosome was $3.54\ \mu\text{m}$ long and V-shaped with $F\%=49.10$. This chromosome showed heteropycnosis on the most parts of the long arm and thus belonged to H-chromosome. The second large chromosome was also V-shaped with $F\%=40.63$, and showed heteropycnosis on the short arm and thus also belonged to H-chromosome. The remaining two large chromosomes were J-shaped. The seven small chromosomes consisted of four v-shaped, two i-shaped, and one m-chromosome, with the latter showing heteropycnosis. Thus the karyotype of this species was formulated as $K(n)=11=2V(H)+2J+6(4v+2i)+m(h)$. The total length of the chromosome complement was $18.91\ \mu\text{m}$.

(3) *Entodon okamurae* Broth. , Plate 1 : 3, Fig. 3, Table 2

Table 2 The parameters of 4 *Entodon* species

species	chromosome No.	chromosome length (μm)			Relative length (%)	Length Form (%)	Type
		short arm	long arm	length			
<i>Entodon obtusatus</i>	1	1.72	2.17	3.89	21.17	44.09	V(H)
	2	1.52	1.53	3.05	16.58	49.87	V(H)
	3	0.67	1.71	2.38	12.92	28.28	J
	4	0.75	1.26	2.01	10.92	37.45	J
	5	0.66	0.66	1.32	7.22	50.00	v
	6	0.61	0.68	1.29	7.01	49.21	v
	7	0.52	0.60	1.12	6.09	46.43	v
	8	0.47	0.52	0.99	5.39	47.58	v
	9			0.96	5.22	0.00	i
	10			0.74	4.05	0.00	i
	11			0.63	3.44	0.00	m(h)
<i>E. compressus</i>	1	1.75	1.79	3.54	18.70	49.10	V(H)
	2	1.02	1.50	2.52	13.30	40.63	V(H)
	3	0.71	1.73	2.44	12.90	29.18	J
	4	0.75	1.22	1.97	10.41	38.21	J
	5	0.78	0.79	1.57	8.29	49.49	v
	6	0.69	0.88	1.57	8.29	43.88	v
	7	0.66	0.75	1.41	7.45	46.59	v
	8	0.63	0.68	1.31	6.94	48.17	v
	9			1.29	6.81	0.00	i
	10			1.14	6.05	0.00	i
	11			0.75	3.98	0.00	m(h)
<i>E. okamurae</i>	1	1.21	1.41	2.62	16.24	45.87	V(H)
	2	0.93	1.15	2.08	12.94	44.62	V(H)
	3	0.66	1.22	1.88	11.64	35.47	J
	4	0.59	1.07	1.66	10.36	35.57	J
	5	0.58	0.72	1.30	8.06	44.44	v
	6	0.63	0.63	1.26	7.86	50.00	v
	7	0.60	0.62	1.22	7.61	49.01	v
	8	0.55	0.66	1.21	7.56	45.39	v
	9			1.07	6.67	0.00	i
	10			1.04	6.47	0.00	i
	11			0.74	4.58	0.01	m(h)
<i>E. giraldii</i>	1	1.31	1.43	2.74	16.17	47.81	V(H)
	2	1.16	1.24	2.40	14.14	48.33	V(H)
	3	0.48	1.29	1.77	10.42	27.15	J
	4	0.63	1.09	1.72	10.18	36.57	J
	5	0.75	0.76	1.51	8.91	49.74	v
	6	0.62	0.68	1.30	7.68	47.85	v
	7	0.59	0.59	1.18	6.98	50.00	v
	8	0.56	0.58	1.14	6.74	49.65	v
	9			1.14	6.74	0.00	i
	10			1.07	6.32	0.00	i
	11			0.97	5.70	0.00	m(h)

This species had the chromosome number of $n=11$, which was confirmed by our obser-

vation on meiosis of the spore mother cells. The morphology of the chromosomes were essentially similar to that of the above two species, *E. obtusatus* and *E. compressus*. The largest chromosome was $2.61\text{ }\mu\text{m}$ long, and the total length of the chromosome complement was $16.08\text{ }\mu\text{m}$. The karyotype was formulated as $K(n)=2V(H)+2J+6(4v+2i)+m(h)$.

(4) *Entodon giraldii* C. Muell., Plate 1 : 4, Fig. 4, Table 2

This species had the chromosome number of $n=11$, which was in accordance with the count reported by Zhou et al (1988). They observed a m-chromosome in their observation at meiosis of spore mother cells, which was verified in our study. The longest chromosome was $2.74\text{ }\mu\text{m}$ long, and the total length of the chromosome complement was $16.97\text{ }\mu\text{m}$. The karyotype of this species is slightly different from those of the above three species in that its fifth chromosome was $1.51\text{ }\mu\text{m}$ long, thus longer than half the length of the longest chromosome, so it should be classified as large chromosome. Therefore, the karyotype of this species was formulated as $K(n)=11=2V(H)+1V+2J+5(3v+2i)+m(h)$.

Discussion

Detailed karyological studies on some *Entodon* species have been made by Yano (1955, 1957), Inoue and Uchino (1969) and Inoue (1983). All these studies showed that the chromosome number of this genus is $n=11$. Our results are consistent with these reports.

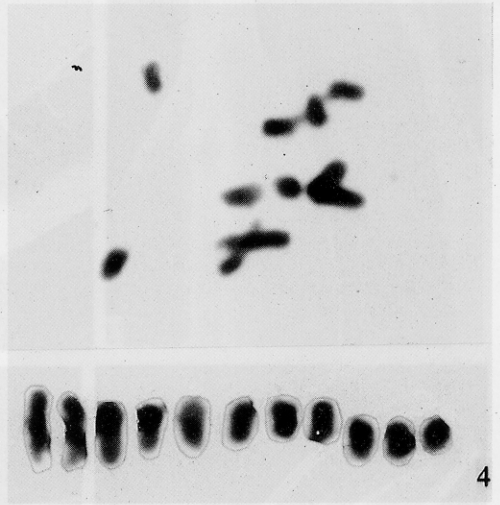
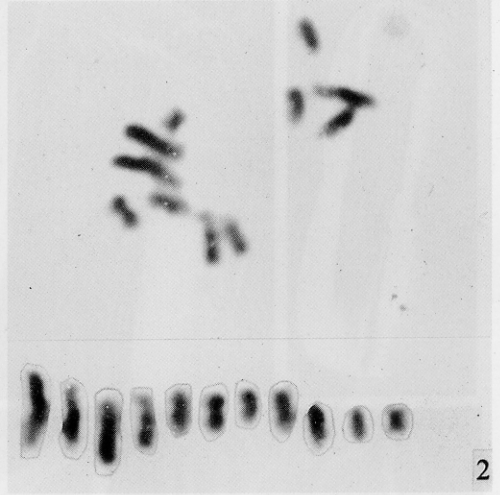
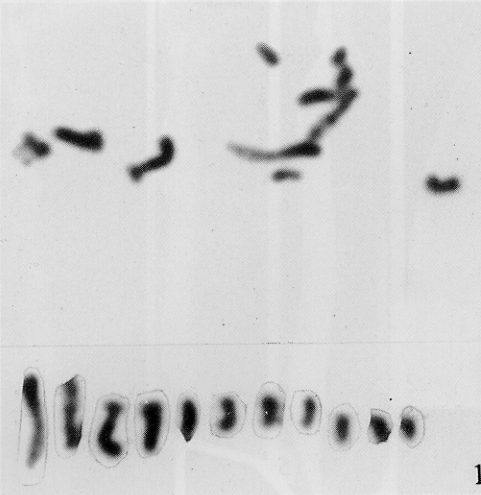
The genus *Entodon* is usually divided into two subgenera, *Entodon* and *Erythropus* (Buck, 1980). Based on his own karyological studies on some *Entodon* species, Inoue (1983) pointed out that the two subgenera had different karyotypes which coincided with the subgeneric classification. Of the four species studied here, three (*E. compressus*, *E. okamurai*, *E. giraldii*) belong to Subgen. *Erythropus*, while *E. obtusatus* belong to Subgen. *Entodon* if according to Buck's classification of *Entodon*. It is noteworthy that *E. obtusatus*, *E. compressus* and *E. okamurai* have the same karyotype, which is slightly different from that of *E. giraldii*. Therefore Inoue's generalization is not supported in our study.

More extensive and intensive karyological studies are needed for better understanding of the systematics of the genus *Entodon*.

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Note: "Explanation of plate" at text



see explanation at the end of text